MURCHÉ'S SCIENCE READERS

BOOK I.

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SCIENCE READERS

BY

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REVISED AND ADAPTED FOR USE IN SCHOOLS, WITH A PREFACE BY
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BOOK I

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PREFACE

Of this series of Science Readers, Books I, II, and III are adapted to Secondary Grades comprising pupils who are in their third and fourth years of school work. Both the reading and the subject matter of Books IV, V, and VI are suitable for Grammar Grades.

At the end of each of the first three volumes will be found a short summary of the lesson. This is a helpful feature. The teacher who reads this carefully, then the reading lesson itself, will secure both the needful knowledge and valuable suggestions for a successful method of imparting it.

Take, for example, Lesson XXII. Read the summary at the end of the volume, and then the lesson itself. Do not let the children read it until you have given them

the science lesson in the manner indicated in the text, which would be something like this:

Let the children have a minute quantity of table salt. What is it? How do you know?

Watch what happens when I put it in the cup. What has happened? How can we tell that it is dissolved in the water? Taste it. What name is given to salt and water? How can we get the salt out of the water again?

Now let the teacher pour the brine into a tin cup, placing it over a spirit lamp of some kind, and go on with other work, stopping only to call the attention of the children to the visibly escaping vapor, which may be proved to be water by holding above it a cold slate. What is happening? Does the salt go off with the water?

Let the children see and taste the salt residue. Tell them of its commercial manufacture.

This lesson should be immediately followed by the substance of Lesson XXIV, taught in a similar way.

After each series of lessons so taught, the part of the book relating to the subject may be used for supplementary reading.

Each reading lesson is illustrated in a way that will serve vividly to recall the teaching, thus emphasizing the important points.

The lessons are progressive, each one of the series being built on the facts taught in the previous lesson. Moreover, the subject matter—the properties of bodies; the nature, growth, and structure of plants; the common types of animals; minerals and metals; the phenomena relating to weather; in short, all the conditions which surround us—is exactly the science which should be taught in the elementary schools.

L. L. W. Wilson,

Philadelphia Normal School.

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BOOK I

Lesson I

Water

Fred and his cousin Willie were two bright boys in the same class at school. They were only little boys, but they were fond of their school and their lessons.

They used to play at school in the evening with Fred's little sister Norah.

Their teacher was giving the class jolly lessons on some of the common things around them. These were not at all like the other lessons of the day. Teacher gave them to the class as a treat. The boys soon began to look forward to them, as the best of all their lessons.

Norah, too, liked to hear all about them from the boys. It was great fun to

sit round the fire in the evening, and chat over the lessons of the day.

The first lesson was about water.

'What do you think, Norah?' said Fred one evening. 'Teacher began to

talk to us about water, by showing us a saucer full of saw-dust.

'He piled up the saw-dust in a heap in the saucer, and then tried to do the same with some water in another saucer.'

'But, of course, he couldn't do it,' said

Willie, 'because you can't make water stand up in a heap. It always keeps a flat or level surface.'

'Yes; and, when it got to the top of the saucer, it ran away over the sides, and on to the table,' added Fred. 'We saw it flow along the table, and fall down to the floor.'

'Why, of course,' said Norah, 'water always flows down. We can see it flow down, if we turn the faucet. It never flows up.'

'Teacher told us to think of the rain, too,' said Willie. 'The drops of rain always fall down—never up.'

'I can show you some drops of water,' said Fred. 'Look; I dip this brush in the water, and shake it. The water will fall from the brush in little round drops.'

Lesson II

WATER—A LIQUID

Norah's mother called her away to

mind baby, before the boys had told her all about their lesson.

She came back as soon as she could, and they began to chat again.

'I wonder whether Norah forgets what we learned about water,' said Fred.

'No,' said Norah, 'I don't forget. I know that water flows, and it always flows down. It keeps a flat surface, and it cannot stand in a heap. It breaks up into round drops, but the drops will run together again, and make a pool of water.'

'Quite right,' said Fred. 'But now I'm going to puzzle you. Can you tell me what shape water is?

'Teacher tried to puzzle us; didn't he, Will? But he soon made it clear. He showed us the saucer, and we saw that it was round. Then he filled it with water, and of course it was easy to see that the water in the saucer was round too.'

'But the water did not remain round,' said Willie, 'for teacher next poured it out of the saucer into a square tin box.'

'I know,' said Norah, 'it became square then, like the box.'

'Right,' replied Fred, 'and then we saw the water poured out of the box into a tumbler; out of the tumbler into a jug; out of the jug into a bottle. It took the shape of the new vessel each time.

'Can you think of any other things, Norah, that would do as water does?'

'I know some,' said Norah. 'Milk and oil, vinegar and tea would do the same.'

'Now, Norah,' said both boys at once, 'you must try not to forget the proper name for all these things. Teacher tells us to call them liquids.

'Liquids flow about, break up into drops, take the shape of the vessel which holds them, and cannot stand in a heap, but always keep a level surface.'

Lesson III

Solids

'You know what happens, Norah, when I pour water on the table.'

'Oh yes,' replied Norah; 'it flows about, because it is a liquid.'

'Now I will put this stone on the table. Will the stone flow away too?'

'No,' said Norah, 'it will stand where you place it.'

'Then would it be right to call the stone a liquid?' said Fred.

'No, it cannot be a liquid, for all liquids flow.'

'We know we can't pick up water,' said Fred. 'It would run through our fingers, and fall in drops on the floor.

'But we can pick up the stone without spilling any of it.'

'Yes,' said Willie, 'and we might shake the stone ever so long, but we

could not shake drops from it, as we did from the water in the brush.'

'I say, Will,' said Fred, 'wasn't it funny when teacher shook the saw-dust into the basin, and asked one of the boys to pick out the piece of wood?'

'Yes,' said Will, 'but there was no piece of wood in the basin, for the little bits of saw-dust do not run together, as the drops of water do.'

'I think,' said Norah, 'I can tell you something else. Water and all other liquids have no proper shape. But if we look at this stone, this brick, or this piece of wood, we can see that each of them has a shape of its own.'

'We know that, when we put some water into the basin, it spreads out to fill it,' said Fred.

'Yes,' said Norah, 'it takes the shape of the basin, and it keeps a level surface.'

'Now watch, while I put this brick into the basin. Does it spread out to fill the basin, Norah?'

'No,' said Norah.

'Does it take the shape of the basin?'

'No.'

'Teacher gave us the proper name for things like the brick and the piece of wood,' said Willie. 'We call them solids.

'Solids are bodies that do not flow, do not break up into drops, have a shape of their own, and do not take the shape of the vessel which holds them.'

Lesson IV

Liquids and Solids

When the boys, a few nights later, called Norah to come and play school, Fred said: 'I want to be teacher this time. I am going to show Norah what we have been doing in school to-day. Mother gave me this piece of wax, and said I might have this old iron spoon.

'Now I will put the wax into the spoon,' said Fred. 'See; it stands in the middle of the spoon.

'I want you to watch what happens, when I hold the spoon over the fire.'

'Why, the solid wax is changing into a liquid,' said Norah.

'How do you know it is a liquid, Norah?'

'It does not stand up in a lump in the middle of the spoon, as it did at first,' said Norah. 'It flows about in the spoon. It keeps a level surface.'

'See,' said Fred, 'I will pour some of it into this pill-box, just as teacher did to-day, and stand the box on the table.'

'That is just what we saw, Norah, when the meat was roasting the other day,' said Will.

'Yes,' said Norah, 'the solid fat was changed into liquid, and fell in drops into the dish. I took it up in the spoon, and poured it over the meat to baste it.'

'Don't you two children chatter so,' said Fred. 'I want to have a look at our pill-box.

'See, Norah, the wax is cool now.

It does not flow about, even if we turn it upside down. It is not a liquid now.

'Suppose I cut the box open,' said Fred. 'Look; here is a round piece of solid wax, the very shape of the box.'

'Why, Fred,' said Norah, 'this proves that liquids do really take the shape of the vessels which hold them.'

'Quite right, clever little sister,' said Fred. 'Now tell me what mother does with the liquid fat in the dripping-pan.'

'She pours it into a basin,' said Norah; 'when it is cold she turns it out as solid dripping, just the shape of the basin.'

'I saw some solid water in a basin the other day,' said Will. 'We call it ice. The cold weather changed the water into ice. When I put the basin on the hob, the solid ice turned into water again.'

'You can't change everything like this,' said Fred.

'No,' said Norah, 'we can't change brick, wood, stone, or slate into liquids.'

Lesson V

The Cat

'How snug and cosy puss looks in front of the fire, mother.'

The children had just been out for

a run, and it was Norah who spoke. 'What a quiet, gentle pussy it is,' she went on.

'Ah,' said her mother, 'she wouldn't be very quiet or very gentle if a mouse were to run out of its hole.'

'No,' said Willie; 'I saw her catch a bird in the garden to-day. She was fierce and angry then. She tore it to pieces and ate it, after she had killed it.'

'What makes her so cruel sometimes?'

asked Norah. 'Can't we teach her better, mother?'

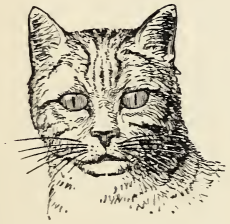
'No,' said Fred, 'we can't; she kills and eats other animals because she was made for it, and meant for it.

'We had a fine lesson at school about the cat to-day. I'll tell you all I can about it. Shall I, Norah?'

'Do, please,' said his sister.

'Then take puss on your lap, Norah,

and we'll begin,' said he. 'First look at her eyes. Now look into my eyes. You see that round black spot in the middle of my eye. That is the pupil of the eye. Light enters the eye through the pupil.



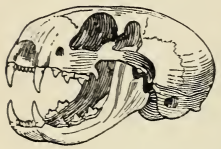
The pupil of pussy's eye is not like ours. In the bright light it is a long narrow slit; when it is dark the pupil opens into a very wide round window.'

'I suppose,' said Norah, 'that is to help her to see when it is dark.'

'It is,' said Fred. 'She wants to see well then, for the mice come out of their holes at night.

'Look at her now while she is stretching herself. What a wide mouth she has, and what long sharp teeth. Four of the

teeth, two in each jaw, are much larger and stronger than the rest. Teacher says they are meant for seizing and tearing the mice and birds. We move our jaw from side to side, as well as up and down, when we chew our food. The cat's jaw cannot move sideways, it moves only up and down. Her jaws as well as her teeth are meant for cutting, not for chewing.



'I wonder whether pussy will let us look at her tongue. Try and open her mouth, Will.' But puss began to growl and look so savage that they had to give it up.

'Well,' said Fred, 'teacher tells us that even the tongue is meant to help the cat in her flesh-eating. It is not smooth, like our tongue. It is set with small, sharp, horny points which stretch backwards. The cat uses her rough tongue to strip the flesh from the bones.'

Lesson VI

More about the Cat

The next evening, as soon as they sat down, Fred began by asking Norah to tell all she could about the cat.

'All we have seen,' said he, 'shows us that the cat was made to kill other living things and feed on their flesh. Even the cat's eyes are meant to help her to catch her prey in the dark.

'Now, sometimes it is so dark that the cat herself can't see. She has to feel her way. How do you think she does this, Norah?' Norah was puzzled.

'Look,' said Fred, 'at that bare patch on each side of pussy's mouth. Her long stiff whiskers grow out from those patches. The cat feels her way along with the ends of these whiskers.

'Now, little girl,' he went on, 'we are going to look at pussy's feet. The front paws have five toes, the hind ones have

four. Puss walks on her toes, not on her whole foot, as we do.

'Look on the under side of the paws and you will see that they all have soft smooth pads. The cat walks on these pads.'

'Oh, I see,' said Norah; 'if the cat made a noise with her feet the mice would hear her and run away. So she has pads to walk on.'

'Teacher pointed out to us,' said Fred, 'the loose, springy body, with its soft coat of fur, almost like velvet. All this is to help the cat to move quickly, and at the same time softly and quietly. She treads very lightly and softly.

'Now, one more look at her feet. If we took pussy up when she was angry, we should see that each toe is armed with a strong, curved, pointed claw.

'We don't see them now; she keeps

them drawn up in a sheath. She only stretches them out when she is angry.'

'It is these sharp claws, I suppose,' said Norah, 'that help to seize the mouse, when she springs upon it.'

Lesson VII

Hard and Soft Bodies

'We had a lesson to-day,' said Fred, 'about solid bodies—some hard and some soft. Teacher showed us that we can call a body hard or soft only when we set it side by side with some other body.

'This is how he did it. He put an apple and a turnip on the table, and side by side with them, pieces of chalk, cork, wood, lead, iron, flint, steel, and glass. Then he set one of the boys to try and scratch these things, with his nail, one after the other. He could pick pieces out of the turnip and the apple; he could

scratch the chalk, cork, wood, and lead; but he could not make the least mark on the iron, flint, steel, or glass.'

'I see,' said Norah; 'then this shows that the iron, steel, flint, and glass are harder than the wood and the lead; and that the wood and the lead are harder than the apple and the turnip.'

'You are a sharp little sister,' said Fred, 'and you are quite right.

'Teacher next gave the boy a knife, and asked him to cut these things. He could cut little pieces off the lead and the wood, but he could not even scratch the steel, flint, or glass.'

'That was a good way, Fred,' said Willie, 'to find out which were the hardest things, by rubbing them one against another.'

'Yes,' said Fred, 'the steel, flint, and glass rub pieces out of the wood and the lead, because they are harder than the wood and lead.

'The steel knife made a scratch on the

iron, because it is harder than iron; but it could not scratch the glass.

'The wood and the lead rub pieces out of the chalk and cork, because they are harder than chalk and cork.

'And the chalk and cork rub pieces out of the apple and the turnip, because they are harder than the apple and turnip.'

'Glass must be very hard,' said Will; 'a steel knife will not even scratch it.

'Teacher showed us that we can just manage to scratch glass with a sharp bit of flint; but we cannot cut it with flint.'

'I've seen a man cut glass,' said Norah.

'Yes, dear,' said Will, 'but he cuts it with a di-a-mond, and di-a-mond is the hardest of all bodies.'

Lesson VIII

Porous Bodies

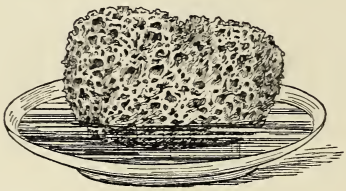
'I wish,' said Fred, 'every fellow in

my class had a jolly little sister, such as I've got, to play school in the evening.

'We had a fine lesson on a sponge to-day. Would you like us to tell you all about it, Norah?'

'That I should,' said his sister.

'Come along then,' said Fred. 'I've got the sponge ready. I will stand it



in a saucer of water, just as teacher did.

'Now Norah shall take it out of the saucer and put it on the table.

'What have you done with the water in the saucer, Norah? It is all gone; the saucer is empty.

'Bring me the sponge. Now squeeze it over the saucer.'

'Oh, I see,' said Norah; 'the water all went up into the sponge.'

'Yes, little girl,' said Fred; 'and now we will see how it got there.

'If you look at the sponge, you will find that there are little holes all over it.

'I will cut a piece of it away, and we shall see that the holes are not on the outside only, but all through the sponge. The sponge is full of holes. Will knows the proper name for these little holes.'

'Oh yes,' said Willie, 'teacher told us to call them pores; and as the sponge is full of pores, we say it is porous.'

'Then I suppose,' said Norah, 'the sponge sucks up the water because it is porous; the water fills up the holes in it.'

'Right,' said Fred. 'Here is a piece of bread. If I stand it in the saucer with only a little water in the bottom, the bread will soon be wet all through.'

'The bread, like the sponge, is porous,' said Norah. 'I can see the holes in it.'

'Yes,' said Willie, 'but teacher showed us that some things may be porous although we cannot see the pores.'

'How did he do that?' said Norah.

'He put a piece of lump sugar and a piece of chalk into a plate, with a little red water in the bottom,' said Willie. 'We couldn't see any pores in the sugar or the chalk, but we saw the red water go up. That proves that there must be pores in them, and that sugar and chalk are both porous bodies.'

'Teacher gave us a long word to think about,' said Fred. 'The word is absorb, and it means to suck up.

'He says all porous bodies absorb or suck up liquids through their pores.'

Lesson IX

The Dog

The boys came home one day full of delight. Teacher had been giving them a lesson on the dog. As they had a faithful old dog of their own, the lesson pleased them very much.

'Shall we bring Ponto in, and have a

chat about him?' said Fred. Of course they all said 'yes,' and a minute or two

later the children were sitting on the floor with Ponto in the middle.

'Now first of all, sister, what does Ponto like best for dinner?' said Fred.

'He likes a piece of meat better than anything,' said Norah.

'Yes,' said Fred, 'the dog, like the cat, is a flesh-eater.

'Open your mouth, Ponto, and let us

have a look at your teeth, old boy. Look, Norah, his teeth are sharp and pointed. They are just like pussy's teeth. They are made for cutting through flesh, not for chewing or grinding. The lower jaw has only one movement—up and down.'

'So far the dog is very like the cat,' said Norah.

'Now let us look a little farther,' said Fred. 'Ponto's head is not like the cat's head. It is longer and more pointed. If you notice his eyes, you will see that they have no curtain in front, no long narrow slit, like the cat's eyes.

'Now let us have a word about his feet. Hold up your paw, Ponto. That's right, good dog.

'If we look at all his paws, we shall see that, like the cat, he has five toes on the front and four on the hind ones.'

'Yes,' cried Norah, 'and the toes are padded. Does Ponto walk on his toes, too, Fred?'

'Yes, the dog walks on his toes.'

'But,' said his sister again, 'I can hear Ponto's feet on the ground as he runs. I can't hear pussy's feet. How is it, if both of them have pads, Fred?'

'Ah,' said Fred, 'if you look you will see that Ponto cannot draw back his claws as the cat does. The claws rub the ground at every step, and make a noise.

'There is just one thing more,' Fred went on. 'The dog's tongue is soft, smooth, and wet, not rough like the cat's tongue. He does not use it as the cat does.

'I am going to tell you something

very funny though. The dog per-spires through his tongue. The sweat never comes out on his skin. When you see Ponto lying down in the sun, with his tongue lolling out, you will know what it means now, Norah.'

Lesson X

Dogs

'I say, boys,' said Norah, 'what should we do without our dear, faithful, old Ponto? He is such a clever, loving, sensible old fellow.'

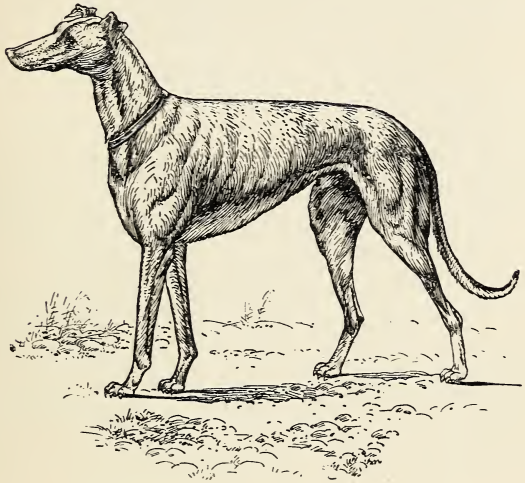
'Well, I couldn't do without him,' said Fred. 'Teacher says that the dog is the very best friend man has among the animals, and I'm sure of it.

'There are many kinds of dogs. First there are the Hounds. These are the best runners. They are all used in hunting.

'The Grey-hound is the swiftest of all. It has a long, slender body and legs. It

is used for hunting the hare. It chases its prey by sight.

'The Stag-hound is the largest and



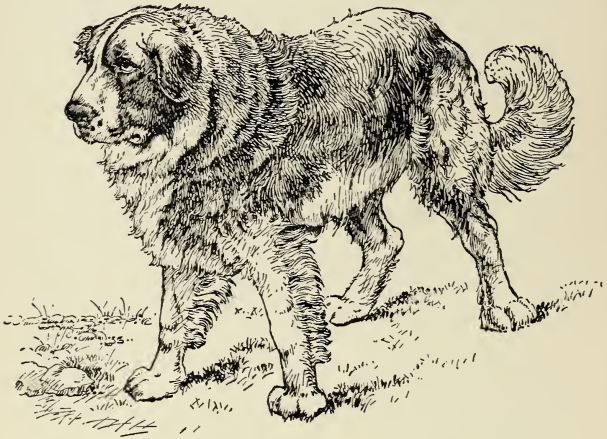
strongest of the hounds. It has a rough shaggy coat. They use it for hunting the stag.'

'Then,' Norah joined in, 'I have heard of Fox-hounds for hunting the fox; and there are Blood-hounds and Deer-hounds.'

'Those that you speak of,' said Fred,

'have a strong sense of smell. They chase their prey by the scent.

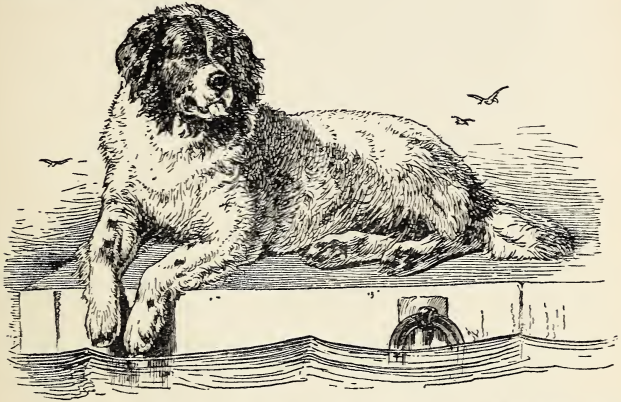
'The Spaniels are grand dogs too. Here is a picture of one of them.



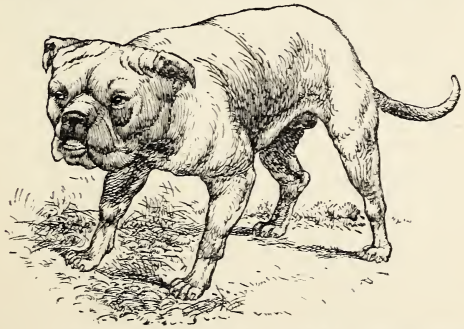
I found it on this paper about dog biscuits. Look at the fine big head, and the long shaggy coat. It is a Saint Bernard dog. In some lands these grand dogs are used to find people, who have been buried in the snow.

'The other one is the New-found-land

dog, a noble fellow, that saves people from drowning.

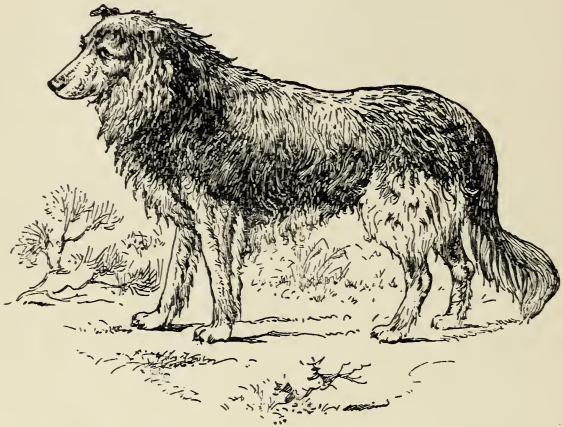


'The Bull-dogs are mostly kept as watch-dogs, to take care of the house at



night. The biggest and strongest of them is the Mastiff.

'The Sheep-dog is the most clever and sensible of all. This dog helps the



shepherd to take care of his sheep.'

Lesson XI

A Piece of Clay

'Will and I have had a rare run since we left school,' said Fred. 'We had a lesson on a piece of clay to-day, and we wanted to find some clay for ourselves. Well, we came at last upon some men digging, and we got some clay from

them. Here it is. Now we will settle down for our chat.

'I told you,' Fred began, 'that the men were digging this clay out of the ground. Teacher gave us a name for the clay, because it is dug out of the ground. Clay is a mineral.

'Will has a piece of dry clay. My piece is moist; it was only just now dug up. We will look at Will's piece first. You can tell Norah all about it, Will.'

Will put his piece of dry clay into a saucer, with a little water in the bottom. When he asked Norah to take the clay out of the saucer, the water was all gone.

'Oh, I know,' said Norah. 'The dry clay is just like the sponge; it sucks up, or absorbs the water. It must be porous.'

'Dry clay is porous,' said Will, looking pleased; 'and it absorbs water through its pores.'

Fred now put his piece of clay in the saucer of water; but after waiting some

time, they saw that none of the water was gone out of the saucer. He poured some more water on the clay, but it only rolled off into the saucer.

'This is very funny,' said Norah. 'Isn't the moist clay porous too?'

'No, sister: moist clay is not porous; it does not absorb water,' said Fred.

'Now look, Norah,' added Fred, 'and I will show you something else about this moist clay. Watch me while I work it up in my hands. I can make all sorts of things with it. This would do for a saucer; now let us break up the saucer, and mould or shape the clay into a little basin. See, it is done.

'Teacher says that things, which can be moulded into all sorts of shapes like this, are said to be plastic,' added Fred. 'Don't forget this word, Norah.'

'I suppose,' said Norah, in reply, 'the dough with which mother made the meat pie to-day is plastic, for I saw her work it up in her hands.'

Lesson XII

Clay—Its Uses

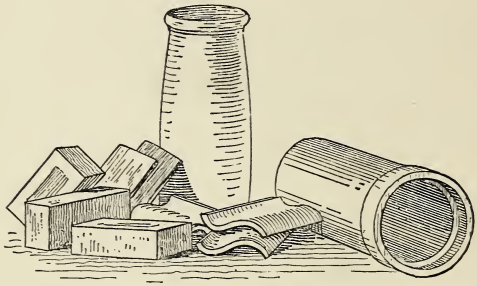
'I never knew till to-day,' said Fred, 'what a useful thing clay is. It is useful because it is plastic.

'You know we made a saucer and a basin with our pieces of clay?'

'Yes,' said Norah, 'here they are. I put them on the shelf.'

'Do you know,' he said again, 'that all our saucers and basins, and cups and jugs, and plates and dishes, are made of clay too?

'Yes, and so are the bricks and tiles and chimney-pots for building our houses; the drain-pipes for taking away



waste, and the flower-pots for our gardens.

'All these things are made of clay. Clay is earth. This is why we sometimes call the things earth-en-ware.'

'What a useful substance clay is,' said Norah. 'I suppose all these things are moulded into the right shape while the clay is moist and plastic. But how are they made hard, like this plate?'

'They have to be baked in very hot

ovens,' said Fred. 'Bricks, after they are moulded, are piled in a great heap, and a big fire is made in the middle of them. This fire is kept burning for weeks. When the baking is over, the things are hard and firm, and will always keep their shape.

'If we drop the cups and saucers on the floor they break in pieces. They are brittle as well as hard. The moist clay was not brittle, for we could throw it down, or even strike it with a hammer, without breaking it.'

'Did the baking make it brittle, Fred?'

'Yes, it did,' said Fred, 'and it did something more. The moist clay was plastic. But could I mould this piece of flower-pot into any other shape?'

'No,' said Norah.

Willie, who had been very quiet for some time, joined in now and said, 'Don't forget, Norah, that the clay, after it is baked, will never be plastic again.'

Lesson XIII

Clay—Its Uses

The children were called away before they could finish their chat about clay. They had to leave it till some other time.

The next evening Fred began by making a little rough basin with his piece of clay, just as he had seen teacher do. He then filled the little basin with water.

'I know what that is for,' said Norah. 'You want to prove that the moist clay is not porous.'

Fred then put a piece of dry brick into a basin, and filled the basin with water to the brim. They waited for a minute or two and then he said, 'Look, Norah, some of the water has gone. What has become of it? It has not been spilt on the floor.'

'I suppose it has gone into the brick,' said Norah.

'That's right,' said Will. 'Now what does this show?'

'If the brick has sucked up the water, it must be porous,' said Norah.

'So it is,' said Fred. 'The baking made the clay porous.'

'Now listen,' he added. 'We want our bricks to be porous, so that any water that gets into them may drain out. But our cups and saucers, jugs and basins, and most of our earth-en-ware things have to hold water. They must not be porous, or the water would run away.'

'But you told me they were all porous after they had been baked,' said Norah.

'Don't you be in a hurry, little sister,' said Fred. 'Here is a flower-pot, and here is a tea-cup. The tea-cup was as rough as the flower-pot at first, but it is smooth and shiny like glass now. We say it is glazed. This glaze is not porous, and liquids will not pass through it.

After the cup is baked it is dipped into the glazing mixture and baked again. When it comes out of the oven this time it is smooth, shiny, and not porous, just as you see it now.'

'What clever boys you are,' said Norah. 'You are very good to tell me all these fine things.'

Lesson XIV

The Cat's Big Cousins—The Lion

One morning after breakfast Fred's father said, 'I've heard you children talking about the cat and the dog. Would you like to go with me to the Zoo, to see some of the cat's big cousins, and some wild savage dogs?'

The children could not speak, but they clapped their hands and shouted with glee. As soon as they were ready, off they started. When they reached the place, father led straight to the great cage where the lions were kept.

There were two of them in the cage—the lion and his wife, the lioness.

What strange feelings the children

had, when they looked for the first time on these great fierce cats!

It was a bright sunny day, and the

first thing Fred took notice of was the lion's eye.

'Look, father,' said he, 'the pupil of his eye is just the same long narrow slit as we saw in the cat's eye.'

'Yes,' said his father, 'but if you could see it at night it would be wide open. It would look like a ball of fire.'

'What a grand noble head he has!' said Willie.

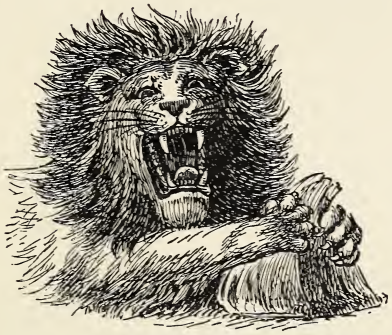
'Yes,' said his father, 'the great shaggy mane gives him that noble look.'

It was the time for feeding the animals, and the children saw the men coming along with the food in a wheel-barrow. The lions saw him too, and they began to lash their tails and growl. At first it was a low grumbling sound, but it got louder and louder. It ended at last in a roar that made the children cling closer to their father.

'What a mouth he has got!' said Fred,

'and just the same long, sharp, cruel teeth as the cat, only so much bigger.'

The men came, and threw in for each animal a great joint of meat, enough to



feed a small family for a week. With a savage growl the lions sprang at the meat. The children could see their strong curved claws, as they tore the meat to pieces.

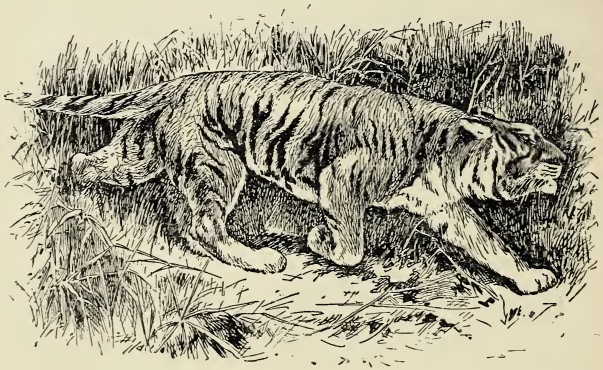
'Just think,' said the father, 'of these fierce animals in the lands where they are found wild. They live in the forests, and prey upon animals as large as the horse and cow. Sometimes they spring upon a man and carry him off in their

strong claws. They sleep in their dens or holes all day long, and at night come out to prowl through the forests for their prey. One spring, and one blow from that great paw, is enough to fell an ox.'

Lesson XV

The Cat's Big Cousins—The Tiger

'Come along, children,' said father;



'there are more of these big cats to see yet.' He led them to another very large cage, where there were quite

a dozen great animals. They looked just like great cats. The children at once thought of Tabby at home.

'These are tigers,' said the father. 'How savage that one looks, Fred! He would like to get hold of you.'

'They have the same eyes as the lion and the cat for seeing in the dark,' said Fred. 'Look too at that great fellow with his mouth open. There are the same great teeth in front. They would quickly tear you to pieces, if he once got hold of you.'

'Just look at his great paws too, father,' said Norah. 'Has he got the same sharp claws?'

'Yes,' said her father, 'if you look at that fellow in the corner, growling over his meat, you can see them.

'The lion and the tiger, you see, are both very very much bigger than the biggest Saint Bernard dog you ever saw. The tiger's body is longer than the lion's body, but he does not stand quite so

high. They both lash their long tails when they are angry.'

'What a fine striped coat the tiger has,' said Norah, 'and how smooth and glossy it is!'

'Yes,' said her brother, 'but the lion's coat is not smooth and not striped. He is covered with rough tawny yellow hair.

'After all,' he added, 'that grand mane makes him look a more noble fellow than the tiger.'

'Think of them,' said the father, 'in their native forests. They are a terror both to men and beasts. The lion kills his victim only when he is hungry. The tiger seems to delight in blood. He kills only for the sake of killing.'

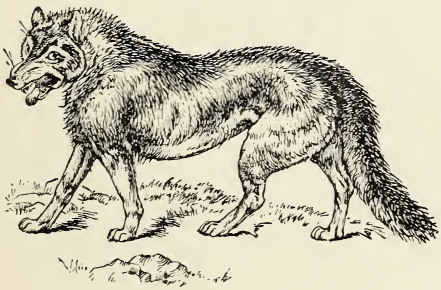
Before they went away their father took them to see the leopard, the panther, the puma, and some other great cats. The children were much struck with the handsome spotted coat of the leopard.

Lesson XVI

Wolves and Foxes

'I think we will go now and see some of the savage cousins of our dear old Ponto,' said father.

He took them first to the wolf's cage.



The children could see at once that the wolf is really a wild, fierce sort of dog. 'Look at him,' said father. 'He has the same pointed head, the same wide mouth, the same long sharp pointed teeth as the dog. He is in every way like the dog; but the dog is tame and gentle, while he is savage and wild.'

'There is a cruel snarling look about his mouth that I don't like,' said Fred. 'How he shows his teeth too. Yes, he looks very savage.'

'Wolves live to-gether,' said father, 'in large numbers. They hunt their prey in a pack—a great many all together. They are cowards, although they are so fierce and strong.

'They hunt their victim by chasing it and running it down. They have a very sharp sense of smell. They can scent their prey a long way off.'

'I am glad there are no wolves in our country,' said Fred.

'Come along now, children,' said father, 'I've another fierce wild dog to show you. Here he is; we call him a Fox.

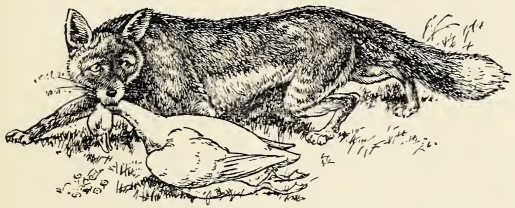
'You see he is very like a dog. What a fine bushy tail he has!'

'I have heard of foxes in the country,' said Fred.

'Oh yes,' said his father, 'we have

plenty of foxes. They live in holes in the ground—not a great many together, but only Mr. and Mrs. Fox and their little ones.

'Mr. Fox goes out when night comes,



and prowls around the farm-yard, and the hen roost, to see what he can get.'

'Oh yes,' said Willie, 'I saw a picture the other day of a fox running away, with a fine big goose in his mouth; I suppose he was taking it home for supper.'

Lesson XVII

A Piece of Putty

One day when the boys came home from school they found a man at work

putting some new panes of glass in the window.

'Oh, this is luck,' said Fred; 'I'll ask him for a piece of his putty, and then we can have a chat about it.'

'Did you see the man rolling the putty about in his hands, Norah?' he asked, as soon as they sat down.

'Yes,' said Norah, 'and I knew at once that putty must be a plastic substance.'

'Quite right,' said Fred. 'Now I will show you some of the things we have learned about putty to-day. Look; I will make it into a little cup, and then fill it with water, just as teacher did.'

The children watched it for some time, and then Willie said, 'I am sure Norah can tell us all about it now.'

'Yes,' said Norah, 'the water stands in the cup, as it stood in the cup of moist clay. The putty is not porous—water will not pass through it.'

'Quite right,' said Will. 'Teacher

told us to say that putty is water-proof.'

'Now let me have a turn,' said Fred. 'But what a mess our hands are in. How this putty sticks to our fingers.'

'I say, Fred,' said Will, 'do you think Norah can tell us why the workman was glad to have sticky putty? We know, don't we?'

'Why, I suppose it is because he wants it to stick fast to the wood of the window-frame,' said Norah.

'That's my clever little sister once more,' said Fred.

'Now, Norah,' he went on, 'we have been moulding and working up the putty, because it is soft and plastic. But try and work up this piece.'

'I cannot press it,' said Norah; 'it seems as hard as a stone.'

'Yes,' said Fred, 'and so will this piece be if we leave it for a few days. Now let us see why putty is so useful.'

'It is soft, plastic, and sticky when we

use it; it soon becomes almost as hard as stone. It is water-proof, and will not let the rain come in.'

Lesson XVIII

PUTTY—WHAT IT IS

'The other day,' said Fred, 'we had a chat about putty, and we found out why it is so useful.

'Teacher has been telling us to-day what putty is. Would you like to hear all about it, Norah?'

'Oh yes, please,' said Norah.

'Well then,' said Fred, 'think of the two plastic substances, clay and putty. Clay, you know, is dug out of the earth. It is a mineral. But we don't dig putty out of the ground.

'It is made of two substances—whiting and linseed-oil.

'You know what whiting is. You have seen mother use it to clean the pots and pans. It is only chalk. But can you tell me how we get chalk?'

'I suppose it is dug out of the ground, like clay and stone and sand,' said Norah.

'Quite right,' said Fred. 'It is a mineral. Teacher showed us a piece of chalk, just as it was dug up, but it was mixed with bits of stone and dirt. To make whiting, we must get rid of all this. The chalk is broken up in little pieces, and put into water. When the water is stirred, it looks just like milk. This milky-looking water is poured through a sieve, and all the dirt and stones are kept back. The chalk or whiting sinks to the bottom, and is dried after the water is poured off.

'Here is some linseed-oil. Father gave it to me. This oil is made from linseed—the seed of the flax plant. You know we get linen from the flax plant.

'Pour a drop into your hand. It feels sticky. It is the oil, you see, that makes the putty sticky.

'If I drop a little of the oil on this

sheet of paper, it will dry very quickly; and water will run off the oily paper, but will not go through it, because the oil makes the paper water-proof.

'It is the linseed-oil that makes the whiting into plastic, sticky, water-proof putty, and causes it to dry and harden quickly.'

Lesson XIX

Gutta-Percha

'What a silly little girl you are, Norah,' said Fred one evening. 'You should not put your feet on the fender, so close to the fire.' Her father had put gutta-percha soles on her boots a few days before, to keep her feet dry in the winter.

Now the boys had just had a lesson on gutta-percha at school. Fred thought this would be a good time to let Norah hear something about it.

'Wait a minute,' he said; 'I know where I can find some gutta-percha.

Father left it when he mended your boots.'

Fred was soon back with the piece of gutta-percha. He brought with him, too, a basin of hot water.

He put the piece of gutta-percha into the boiling water, and after a few minutes took it out again, just as he had seen teacher do in school.

'Now,' said he, 'take hold of the gutta-percha. Squeeze it in your hand. What have you found out?'

Norah was full of delight. 'Why,' she cried out, 'the gutta-percha is soft and plastic now.'

'Yes, it is,' said Fred; 'I will mould it into a little cup, just as teacher did this morning.

'What was it that made the clay plastic?'

'Water,' said Norah.

'What makes putty plastic?'

'The linseed-oil.'

'Quite right,' said Fred. 'Now we

have got a new substance—gutta-percha, that is made plastic by heat.'

'And now,' added Willie, 'Norah knows why she must not put her boots, with gutta-percha soles, near the fire. The soles would get soft with the heat of the fire, and break away.'

'Let us look,' said Fred, 'at our little cup. See, it is cold, and quite hard once more. It is not plastic now.

'Look again, while I fill the cup with water. None of the water runs through. Gutta-percha is water-proof.'

'Yes,' said Will, 'that is why it is so useful for boots. It keeps our feet dry.'

Lesson XX

A Piece of Salt

'Fred, you might let me be teacher to-night,' said Willie. 'I want to talk about salt.'

'All right, mate,' said Fred, 'and I'll go and ask mother for a lump of salt.'

Fred was soon back with the things that were wanted.

'Now, Norah,' said Will, 'I want you to put a piece of the salt in the water. That's right. Now stir the water.

'Where is the salt? Can you see it?'

'No,' said Norah, 'I cannot see it; but I am sure I put it in the water.'

'Put another piece in and try again,' said Will. 'Can you see the salt now?'

'No, I cannot see it now,' said Norah. 'What has become of it? Has it melted, Willie?'

'Ah,' said Will, with a knowing smile, 'I thought you would ask that. Now just tell me what you saw, when I put the piece of wax in the spoon, and held it over the fire.'

'The solid wax became liquid, and flowed about in the spoon,' said Norah.

'Quite right,' said both boys, 'that is just what we mean by melting. The solid wax melts when it becomes liquid. We can see it when it is melted. But

we cannot see the salt in the water. The salt is not melted.'

'Teacher says the water loosens and breaks up the salt into tiny pieces, so small that they cannot be seen,' said Fred.

'You must try to keep in your mind the word, which teacher gave us for all this. We say that we dis-solve salt in water, because the salt loosens and breaks up in the water, so that we cannot see it. Teacher says to dis-solve means to loosen or break up. Don't forget that we can dis-solve salt, sugar, soda, alum, and lime.'

'But,' added Will, 'we can't dis-solve every-thing, Norah. We can't dis-solve stones, chalk, iron, glass, or wood.'

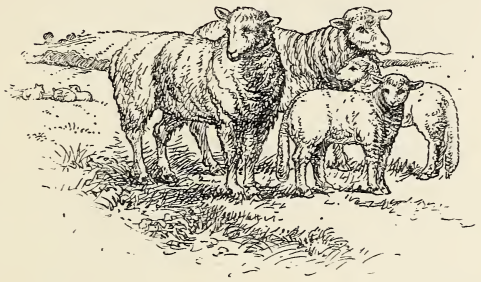
Lesson XXI

The Sheep

'Come into the field,' said Fred, 'and let us watch the sheep feeding. But you must not go too near them, for they are very timid, and will run away.

'Can you tell me why the sheep has that thick woolly coat, Norah?'

'I suppose it is because it always



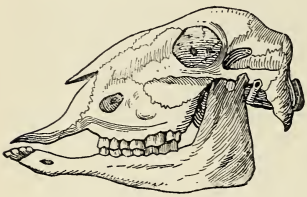
sleeps in the open air at night. The thick coat of wool is to keep it warm.'

'Quite right. Now let us sit down here, and watch the sheep eat the grass. You see they are all eating in the same way. They tear off one mouthful after another, and swallow it at once. They do not wait to chew it. They will not leave off till they have eaten as much as they want. Then they will lie down on the ground very quiet and still.'

'Some of them seem to have had

enough already,' said Norah, 'for they are lying down over there. But they all look as if they were chewing now, Fred.'

'So they are,' said Fred. 'I will tell you all about it. First of all, then, I must tell you that the sheep has no teeth at all in the front of its top jaw. It has a thick, hard pad there instead of teeth. It collects the grass, a mouthful at a time, with its long tongue and lips. The sharp cutting teeth in front of the lower jaw press the grass against the pad and tear it off, and then the sheep swallows the whole of it just as it is.



'The mouthfuls of grass pass down into a big bag, which we call the paunch. All the time the sheep is lying down, it is bringing up the grass into its mouth again to chew it. When it is chewed the sheep swallows it again, but it goes down now into another stomach.

'We say the sheep chews the cud, for the grass is brought up in little balls or cuds to be chewed.'

'Look at the sheep's feet now,' said Will. 'They have four toes; two large ones in front, and two little ones behind. The sheep walks on the two front toes. Each toe has a hard horny case over it. We call the sheep's foot a hoof, and because it is split in two, we call it a cloven hoof.'

Lesson XXII

Salt

The boys came running home a day or two later, as fast as their legs would carry them.

'Oh, Norah,' they both shouted, as soon as they got their breath, 'we've got something fine to show you to-night.'

'I'll go and see what I can find,' said Fred.

After tea Fred said, 'Now, I'm teacher to-night, so sit down in your places.

'I've got some salt and a tumbler of water, just as we had the other night,' he began. 'Now we will put the salt into the water and stir it up.

'What happens to the salt, Norah?'

'The salt dissolves in the water,' said his sister. 'It is there, but we cannot see it.'

'Quite right,' said Fred. 'Teacher says we can call this salt water brine. Brine means salt water.

'Now, little girl,' he went on, 'suppose I told you that you must get the salt out of the water. That would be a puzzle for you, wouldn't it?' Norah looked puzzled.

'See me do it, then,' said clever Fred. He had found an old tin lid. He filled this with the brine, and stood it over the fire. Soon the water began to boil, and a cloud of steam rose from it.

They watched it for a long time, till all the water had boiled away.

'There,' cried both boys with a shout and a laugh, 'that's just what teacher did. We'll soon get the salt back now.'

'Give me a bit of rag,' added Fred, 'so that I can lift the lid off the fire without burning my fingers. There, now we will let it get cold.'

As soon as it was cold enough to handle, Fred showed them that there was something left behind in the tin.

'See,' said he, 'I will scrape it up in a little heap.

'Now dip your finger into it, Norah, and taste it.' Norah did so, and found that it was real salt.

Fred had got the salt back by boiling the brine.

Lesson XXIII

The Pig

'Father,' said Fred, 'will you take us to see Mr. Brown's pigs? We had a

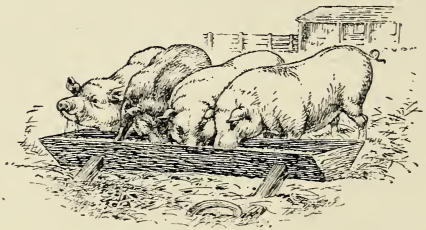
lesson about the pig to-day, and I want to tell Norah all about it.'

They were out together for a walk, and Fred thought it would be a good chance to see the pigs.

'Here we are at last,' said their father. 'Now let us have a look at the pigs. How they are grunting and squeaking. The man has just fed them.'

'What hungry, greedy things they are!' said Norah.

'Let us see what they are eating,'



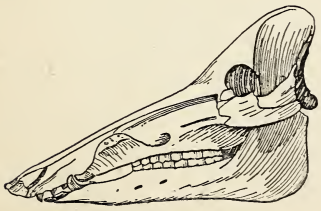
said the father. 'Look into the trough, and you will see pieces of bread, meat, bones, potatoes—waste of all kinds from the table. They eat anything that comes in their way.'

'Teacher says,' added Fred, 'that they

like to grub in the ground for acorns, beech-nuts, and roots. Look at that fellow's broad snout. It is very hard, tough, and strong. It is meant for grubbing in the ground.'

'Yes,' said Will, 'and teacher told us to think about the cat, the dog, and the sheep. They are not meant to grub in the ground with their noses. They cannot do it. They need not do it, for they do not dig their food out of the ground.'

'If we could look into the pig's mouth,' said their father, 'we should see that he has great grinding teeth behind like those of the sheep, as well as sharp-pointed teeth in front like those of the flesh-eaters.'



'Yes,' said Fred, 'the pig lives on flesh as well as other food, because some of his teeth are meant for tearing flesh, and others for chewing and grinding. He can move his jaw, too, from side to side, as well as up and down.

'Now notice the eyes and ears. The eyes look small, but they are very sharp. The ears are large and wide open. They too are very sharp. The fierce flesh-eaters want sharp eyes and ears, to help them to catch their prey. The sheep and the pig are timid creatures. Their sharp eyes and ears are to warn them against their enemies.'

'Shall we look at the feet next?' said Willie. 'The pig's foot is a cloven hoof, just like the foot of the sheep.

'Teacher told us not to forget that most of the animals with a cloven hoof chew the cud, as the sheep does.

'The pig does not chew the cud. He has only one stomach. He chews his food before he swallows it, and does not

bring it back into his mouth to chew it.'

Lesson XXIV

Rock-Salt—Table Salt

'I want to have a talk to-night,' said Fred, 'about the salt we use at our meals. Shall we, Norah?'

'Oh, that's just what I wanted,' said his sister. 'I have been looking at the lump of white salt in the cupboard all the week. I can't make out where it came from.'

'Well then,' Fred went on, 'teacher tells us that, deep down in the earth, there are great solid beds of salt, that stretch for many miles.'

'Yes,' Will joined in, 'but it is not clean, white salt, like the salt we see. It looks like stone, it is smooth and shiny; and it is brown, not white. Teacher showed us a piece of it. It is called rock-salt, for it is like rock.'

'Teacher put a piece of this rock-salt

in water, and we saw it dissolve, like other salt,' said Fred. 'I wonder whether Norah forgets the name for water with salt in it.'

'Oh no,' said his sister quickly, 'we call it brine.'

'Well now,' said Fred, 'teacher asked us to think about the rain. It falls on the ground, but what becomes of it then?'

'Why, it soaks into the earth,' said Norah, 'because the earth is porous, and absorbs it.'

'We are making our little girl very clever,' said Fred, 'but she is quite right. Isn't it jolly, Will, to have a fine teacher? We couldn't tell Norah all these things, if he did not take a lot of trouble to make it easy for us.'

'That's what I say,' said Willie.

'Now tell us, Norah,' said Fred, 'suppose some of this water, as it soaks down into the earth, comes to one of these beds of rock-salt. What would it do to the salt?'

'Why, I suppose it would dissolve the rock-salt, and make brine,' said his sister.

'You are right,' said Fred. 'That is just what it does. Teacher says when men want to get this brine, they bore a hole through the ground, till they come to the bed of salt. Then they put a long pipe down the hole. The brine runs into the pipe, and then they pump it up.'

'I think I can tell you the rest,' said Norah, who was busy thinking. 'They boil the brine, and the salt is left behind.'

'Yes, they do,' said Fred. 'They boil it in great pans as big as this room. And that is how we get salt for the table.'

Lesson XXV

A Plant

'I wonder,' said Fred, 'whether Norah could tell the name for those things, which we dig out of the ground.'

'Oh, you mean minerals,' replied

Norah, 'like chalk, and clay, and salt, and stone.'

'Quite right,' said Fred. 'But teacher showed us some things that are not

minerals, although we get them out of the ground. Think of all the pretty flowers in the beds, the carrots, turnips, beans, and potatoes in the garden, the green grass, and the great tall trees.

'We get them all out of the ground, but they are not minerals. They live and grow in the ground. We call them plants. We know they live, because if we treat them badly we can see them die. Minerals lie in the ground, but they are not living things, and they do not grow. Plants are living, growing things.

'Let us look at some plant in the garden. We shall find that one part of it is not at all like another part. Teacher broke a stone with the hammer, and we saw that one piece of the stone is just the same as another. All minerals are like the stone in this. They have no distinct parts. But each part of the plant is unlike any other part, and has its own work to do.

'Look at this plant, and tell us, Norah, what parts of it you can see.'

'I can see the part that comes out of the ground, and rises up into the air,' said Norah.

'Yes,' said Fred, 'that is the stem or stalk.'

'Then,' said Norah, 'I can see the green leaves on the stalk.'

'Quite right, but is there no other part?'

'Oh, I know,' said Norah, 'you mean the root, which we can't see, because it is in the ground.'

'Don't forget then,' said Fred, 'that every plant must have a root, a stem, and leaves. The root feeds the plant.'

'Now come to the gate, where the sweet-peas are growing over the arch,' said Fred again. 'Can you

see anything here that we did not see in the others?'

'Oh yes,' said Norah, 'there are pretty flowers on these.'

'So there are,' said Fred, 'and besides the flowers there are pods with seeds in them. These plants have been growing much longer than the others.'

'I see,' said Norah, 'as soon as they began to grow they had a root, a stem, and leaves. When they got big, the flowers and the pods with their seeds came.'

Lesson XXVI

Sugar

'Sugar, like salt, is a substance we can dissolve in water,' said Fred. 'Salt is a mineral. It comes out of the ground. I want to tell you something about sugar to-night. But in the first place, sugar is not a mineral.

'Take this cabbage leaf in your hand and squeeze it. What do you see?'

'My hand is wet,' said Norah.

'Yes,' said Fred, 'it is wet because you squeezed some juice out of the leaf. All plants are full of juice of some sort; we call it the sap.

'Teacher showed us a picture of a great plant called the sugar-cane. It grows in very hot lands far away. It has a very tall stem, but no branches; only some big broad leaves up the stem.

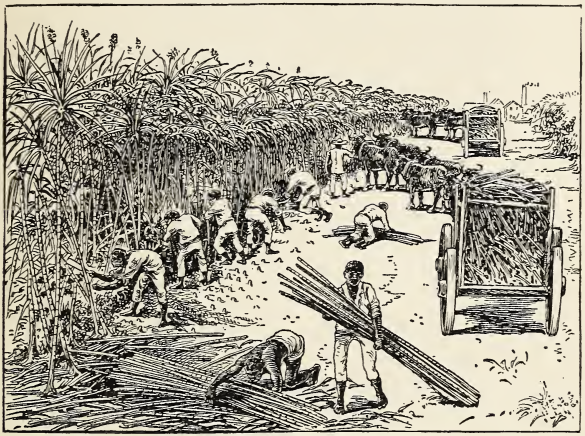
'This sugar-cane, like all other plants, is full of sap. When it is full grown, the sap is very sweet.'

'Oh, I see,' said Norah; 'then the sugar comes from this sweet juice.'

'Wait a minute,' said Fred, 'and you shall see.

'When the men know that the canes

are ready, they cut them down and saw them into short pieces. Then the pieces are crushed between heavy iron rollers.'



'That is to squeeze out the juice, of course,' said his sister.

'Right,' said Fred.

'Now, little sister,' he added, 'tell me what happens when we boil brine?'

'Why, the water boils away,' said Norah, 'and leaves the salt behind.'

'Right again,' said Fred; 'and I think now you will see how they get the sugar from the sweet juice.

'They boil the juice in large pans. The water in the juice boils away, and the sugar is left behind. As it cools the sugar forms into solid grains.'

'You must not forget,' said Willie, 'that this is only raw or moist sugar. It has to be made into white loaf sugar.'

'They leave this moist sugar to drain,' added Fred, 'and what do you think we call the part that drains away from it? It is the molasses we eat on our bread.'

Lesson XXVII

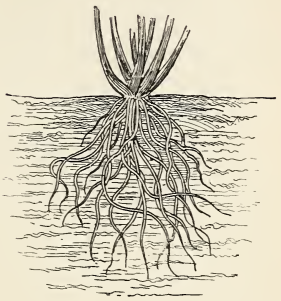
The Root of a Plant

'We had a fine lesson to-day on the roots of plants,' said Will. 'Didn't we, Fred?'

'Yes,' said Fred. 'Let us come into the garden, and have a talk about it. Father asked me to thin out some of the young plants from this bed of stocks. They are growing too thickly together.

If we pull them up, we can learn something by looking at the roots.

'Shake the root clear of the soil that clings to it,' he went on. 'Now what does the root look like, Norah?'



'It looks like a great many white threads or strings, hanging from the bottom of the stem,' said Norah.

'So it does,' said Fred. 'Teacher says that, because these roots are made up of threads, they are called Fibrous Roots. Fibre means a thread or string.

'Now come into my own little garden. Father let me make a radish bed all for myself, and they are growing at a jolly rate. Here, let us pull up one of them. There's a root for you, little girl. Take my knife and cut it across.'

'Why, it is quite thick and solid all through,' said Norah.

'Yes,' said her brother, 'teacher calls them Fleshy Roots, because they are so thick and solid.'

'You know, Norah,' Will joined in, 'carrots and turnips and parsnips are all roots like this one.'

'Teacher told us why some plants

have these fleshy roots and others fibrous roots,' said Fred.

'Let us go back to the young plants, that I began to thin out. Perhaps I can make it clear to you. Father sowed the seeds for these in the spring. By and by,

during the summer, they will bear sweet-smelling flowers, and when the winter comes they will die.

'Teacher says all plants which live only one season, have fibrous roots. The carrot, turnip, and the other plants with fleshy roots would not die in the winter. The thick fleshy root is only a store of food to keep the plant alive, while it can get none from the soil. In the spring such plants wake up from their winter sleep, and burst out into leaves and flowers during the next summer. They do not die till their seeds are ripe.'

Lesson XXVIII

Loaf Sugar

'Oh, do come and tell me how they make that coarse, brown, soft sugar into the hard, white loaf sugar,' said Norah.

The children had just settled down for their evening chat, and our little girl had

been thinking about that white sugar all tea-time.

'Well,' said Fred, 'before I tell you that, I will explain something, that teacher showed us to-day.

'He had some thick flannel bags, one inside the other, and he poured into them some dirty, muddy water. In a short time we saw the water trickle through the flannel, into a basin he held under it. But the water that came through was clear, and not muddy.

'Why did the water drip through the flannel, Norah?'

'I suppose,' said Norah, 'it is because the flannel is porous.'

'Quite right. But why didn't the mud come through too? I think I ought to tell you that,' he added. 'It is because the holes are too small, to let the bits of mud through. The water could pass through, but not the mud.

'Now let us think about the sugar. The coarse sugar is mixed with some

lime, and put into water to dissolve. The syrup is then poured into bags made of thick folds of woollen cloth, and left to drip through into a vessel below. You will see now, I think, why the syrup which drips from the bags is quite clear.'

'The pores in the bags, I suppose,' said Norah, 'won't let the dirt pass.'

'Yes,' said Fred, 'that's right. But, although the syrup is clear, it is still brown. It is next made to run through a bed of small charcoal, made of burnt bones. All its brown color goes as it passes through the charcoal.

'The clear syrup is then put into large copper pans and boiled.'

'Yes, and the rest is easy to see,' said Norah. 'The water boils away, and the syrup gets thicker and thicker.'

'When it is thick enough, it is poured into large moulds to cool,' said Fred. 'It comes out of the mould as a hard, white, solid sugar-loaf.'

'Norah would like to know,' added

Will, 'that the part which drains away from the mould is our golden syrup.'

Lesson XXIX

The Root and its Work

'Now, Norah,' said Fred, 'shall we have another chat about the roots of plants? We did not finish all I wanted to tell you last time.'

'Oh yes, do,' said his sister.

'Then tell me,' said he, 'what the root has to do for the plant.'

'It has to hold the plant firmly in the soil,' said Norah, 'so that the winds and the rain may not tear it up. It has, besides that, to feed the plant with food from the soil.'

'Quite right,' said Fred. 'Now I am going to try and tell you how the root feeds the plant. Come out into the garden, and we will get some roots. Suppose I dig up this carrot.

'Now look,' he went on, 'at these

fine, white threads all over the carrot. Teacher says they are the root-hairs.'

'Yes,' said Willie, 'and they have more to do than any other part of the root. They are the feeders of the plant.'

'Will is quite right,' said Fred. 'Every morsel of food, which the plant gets from the soil, has to pass up through those little hairs.

'Teacher told us,' he went on, 'that these root-hairs are made up of a great many tiny cells or cases, with the thinnest of thin walls. Our eyes are not sharp enough to see them now. But that is what they really are. The thin cells act very much like a sponge. The sponge, you know, absorbs liquids. These root-hairs do the same.

'Now just think over our chat about rock-salt. What happens when the rain sinks into the ground and washes through the salt-beds down below?'

'Oh, I know,' said Norah; 'the water dissolves the salt and carries it away.'

'Quite true,' said Fred. 'Now in the soil of our garden there is all that the plants want for food. But it is no use to the plant, till the rain sinks in, and dissolves it. If the plants do not get water they droop and die. They die because they are being starved. There is plenty of food for them in the soil, but the root-hairs cannot absorb it, till the water comes to dissolve it.'

Lesson XXX

About Burning

'We are going to have a chat to-night about things that burn,' said Fred.

'Father says he is not busy now, so I have asked him to come in and help us, for fear something might happen. Here is father. Now, Norah, go and bring me your rag-bag, with your doll's pieces. I have a lot to show you.'

Fred went and found a candle. He

lighted it, stood it on the table, and spread out all the things they had got.

'Now, children,' said his father, 'I think I had better do the burning, if

Fred will show me what he wants. Then you won't get into mischief.'

'All right, father,' said Fred. 'Are you all ready? Then let us begin.'

His father then held a lot of things, one by one, as Fred gave them to him,

in the flame of the candle. As they caught fire he put them out quickly.

First there were pieces of cal-i-co, muslin, cotton-wool, silk, and cloth from Norah's rag-bag. Then a piece of paper, some feathers, a piece of wool, and a piece of leather. Then a thin stick of wood, some hay and straw, and a strip of whalebone. As they burned, Fred laid them aside in two heaps on the table. Just then Fred's mother looked in.

'What are you children doing?' she cried. 'I can smell something burning. I hope you are not playing with the fire.' She had not seen father there.

'All right, mother,' said he, 'I'm here. They shall not come to any harm.'

'Now then,' said Fred, 'all these things take fire, but some of them burn more fiercely than others. I have put some in one heap, and some in another. In this lot are the silk, wool, cloth, feathers, leather, and whalebone. Don't forget that we get all these things

from animals. They all burn very slowly.

'Show us the burning wool again, father, please. It burns slowly in the flame, and so would all the others.

'In this heap are the cotton-wool, muslin, cal-i-co, paper, hay, straw, and wood. We get these things from plants. If any one of them is put into the flame, it blazes up in an instant. All animal substance burns slowly; those things which come from plants blaze up quickly.

'Our little Norah, with her cotton frock and apron, must keep away from the fire. Her clothes would quickly blaze up, and then she would be burnt to death.'

Lesson XXXI

The Stems of Plants

'Suppose we have a chat about the stems of plants,' said Fred. 'The stem, you know, makes its way upward from

the ground, to get as much light and air as it can for the plant.

'The stems of plants are not all alike. Let us take the trees first.

'They live year after year. They have

a hard woody stem, which we call the trunk. At the top of the trunk are the branches. Bushes and shrubs have a great many stems, but they too are hard and woody.'

'But,' said Norah, 'most of our plants in the garden either die down to the

ground or perish entirely in the winter. What do we call them, Fred?'

'They are called herbs,' said Fred. 'They have soft green stems.'

'These herbs too,' said Willie, 'have all sorts of stems. Let us try and think of what teacher said about them.'

'Well,' said Fred, 'most of them, as we can see by looking round the garden, have strong, stout, upright stems.

'Some, like the scarlet-bean and the hop, are not strong enough to stand upright. We put tall sticks beside

them, and they twine themselves round the sticks. We call them twining stems.'

'We train the sweet-peas on the trellis for support,' said Willie, 'but they are

not twining plants. They have little curling tendrils here and there, which

cling round the trellis. The vine and honey-suckle have tendrils too. We call these climbing plants.'

'Now come and look at these strawberry plants,' said Fred. 'See, as the plant grows, it sends out slender stems along the ground. These we call runners. Each runner sends down, at the next joint, a great many new roots. Plants of this kind we call creeping plants.

'I have one more stem to show you,' he went on. 'We will pull up this root of mint. See, here are the roots. But what are these thick white cords, which run out from the root?

'If you look, you will see buds here and there along the cords. This proves that these cords are not roots, but stems. We never find buds on roots.

'We call stems of this kind underground stems.'

Lesson XXXII

Coal

'I have been thinking over our chat about things that burn,' said Norah. 'Why, Fred, we left out coal, and we all know coal is a good thing to burn. We use it to make our fires.'

'Yes, sister,' said Fred; 'we use coal for fuel, to make our fires. But teacher says there is so much to learn about coal, that we must take it by itself.

'Go and get a piece of coal, Will. We will find out all we can about it.

'Now, Norah,' he went on, 'take the coal in your hand. What can you learn by looking at it?'

'It is black and shiny,' said Norah. 'It looks like a lump of smooth, shiny, hard, black stone.'

'Quite right,' said Fred. 'Now hit the coal with this hammer, and you will see that it easily breaks up into pieces.'

'So it does,' said his sister. 'It is brittle, as well as hard.'

'Now look at your hands, you dirty girl.'

'Oh dear,' said Norah, 'the dirty coal has made me quite black. The black comes off on my hands.'

Fred next took the piece of coal up with the tongs, and held it in the flame of the fire. It soon caught fire, and burst out in a bright flame.

'That's just what I meant, Fred,' said Norah. 'Coal is one of the best things to burn. It burns till it is all gone. It gives out great heat while it burns.'

'Yes,' said Fred, 'that is why we use it for fuel.'

'I should like to know where we get coal from,' said Norah.

'Well then,' said Fred, 'I'll soon tell you. Coal is a mineral, like stone, chalk, marble, rock-salt, clay, sand, and gravel. It is dug out of the ground.

'Men dig great deep holes in the

ground to get the coal,' he added. 'We call the holes mines. The men who dig the mines are called miners.'

Lesson XXXIII

Coal

'You know,' said Fred, 'that coal is a mineral; it is dug out of deep mines.'

'Yes,' said Norah, 'so are clay, and stone, and sand, and iron, and rock-salt.'

'But,' said Fred, 'these things were always in the ground. Coal was not always in the ground. Teacher has been telling us fine stories of a time when the coal-beds were great forests of trees.'

'Yes,' Willie joined in, 'and he showed us some pieces of coal, with the shape of leaves and ferns on them.'

'The forests some time or other sank down and got buried, and now they are changed into coal,' added Fred.

'How strange!' said his sister; 'and is it all true?'

'Yes, teacher says it is quite true.'

'Would you like to see something very funny?' Fred went on.

'That I should,' said his sister.

'Then watch me,' he said.

He brought out, in a very sly way, one of his father's clay pipes, with a long stem. He had filled the bowl with small

dusty coal, and closed it up with clay, just as he had seen teacher do.

He put the bowl of the pipe into the middle of the bright red fire.

'Now, little girl,' said he, 'just watch.'

In a little while they saw some puffs of yellow smoke come out at the end of the stem. The bowl too got red-hot. Then the pipe left off smoking.

'Now, Norah,' said Fred, 'watch again.'

He put a light to the end of the pipe. A bright yellow flame burst out in a moment; and Norah gave quite a start.

'What ever is that?' she said.

'Ah,' said her brother, 'we knew we should give you a surprise.

'That is gas burning at the mouth of the pipe—the very gas that burns in our streets, and shops, and houses.'

Norah had another surprise, when the pipe was taken out of the fire. After it had got cool, Fred broke the bowl, and showed her that it was full of coke.

Lesson XXXIV

Leaves

'You would have liked our lesson to-day about leaves, Norah,' said Will. 'Wouldn't she, Fred?'

'Yes,' said Fred, 'and I think we'll go out into the garden, and pick a few leaves for ourselves, and have the lesson all over again.'

They were soon seated, with the leaves before them, and Fred began :—

'Suppose we start with this one. It is a leaf of the bass-wood-tree at the bottom of the garden. Look, Norah, there are two parts to the leaf. This thin flat broad part is the blade. The long stalk which joins it to the branch is the footstalk.

'Look at all the leaves you have in

your lap. Tell us which is the blade, and which is the footstalk of each.'

'Now look again,' said Willie. 'One side of the leaf is smoother than the

other. The smooth side always points upwards to the sky. The under side is the rough one.'

'Let me point out something else,' said Fred. 'Look at the under side of the leaf. You will see some thick stout lines crossing the blade. They start from the stalk, and run to the edge of the blade. We call these the ribs. They are to support the blade, and

keep it stretched out to the light and air.'

'But,' said Norah, 'I can see a great many other lines all over the blade. They are not so thick and strong, but they run all over it, and cross each other like network. Are these ribs too, Fred?'

'No,' said Fred, 'we call them the veins of the leaves. Nearly all the leaves you have in your lap have veins, which cross each other and form a network. Teacher tells us to call them net-vein leaves.

'Now look at this lily leaf. Hold it up to the light. Do you see veins crossing each other in this leaf?'

'I can see the veins,' said Norah, 'but they run side by side, from one end of the leaf to the other.'

'Teacher says,' added Fred, 'that leaves of this kind have par-all-el veins, and this means that the veins run side by side, as you told me, Norah.'

Lesson XXXV

Coal—The Mine

'Can you tell me, Fred,' asked his sister a few days after, 'how the men get the coal out of the mines in the ground?'

'I'll try,' said Fred. 'That's just what our lesson was about this morning.

'First of all,' he began, 'teacher told us that coal can't be dug up anywhere. The right name for a place where coal can be got is a coal-field. In the ground under the coal-field there is coal.'

Yes,' said Willie, 'but coal, like all other minerals, is always found in beds or layers. These beds are often many hundreds of feet down in the earth.'

'The mine has to be dug right down into the coal-bed,' said Fred. 'At first

it is only a deep wide pit, going down, down, through all the beds that lie above the coal. This pit is called the shaft.

'When the men get to the coal-bed, they don't dig down any more. They begin to dig sideways through the coal itself. They dig out great wide roads, through nothing but coal.'

'But how do the men get down?' asked Norah. 'What do they do with all that they dig out? They must dig up a lot of things before they reach the coal.'

'I thought you would ask that, Norah,' said Fred. 'I will tell you. The men put up a big engine at the top of the shaft. Then they make a great box, which they call a cage. It is big enough to hold a dozen men. The cage is held by very strong chains, and the engine lets it down and draws it up again.'

'I see,' said his sister. 'Sometimes it takes the men up and down. Sometimes

it brings up the earth, and stones, and other things, they dig out. At last it brings up the coal.'

'Quite right, little girl,' said both the boys.

'Now think,' added Fred, 'about the mine itself. As the men dig along their great main roads, they branch off from time to time. They cut out streets and lanes on all sides. It looks like a town under the ground.'

'Oh,' said Norah, with a shudder. 'What a dark, ugly place!'

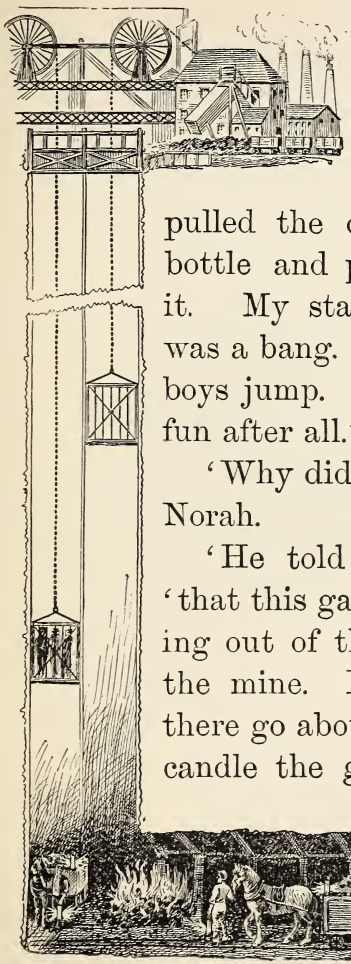
Lesson XXXVI

The Mine and the Miners

'I am glad,' said Willie, 'you were not with us in school to-day, Norah. Oh, we had such a fright for a minute.'

'What was it?' asked Norah.

'Oh, nothing,' said Fred. 'It was jolly fun. You know we made some gas the other night in father's old pipe?



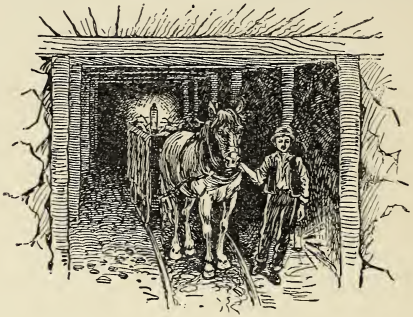
Well, teacher had some of this same coal-gas in a bottle. All of a sudden he pulled the cork out of the bottle and put a light near it. My stars, Norah, there was a bang. It made all the boys jump. But it was fine fun after all.'

'Why did he do it?' asked Norah.

'He told us,' said Fred, 'that this gas is always coming out of the coal down in the mine. If the men down there go about with a lighted candle the gas will at once

take fire and explode. Then the mine is blown up, and perhaps hundreds of men are killed. The gas in the bottle gave us a good idea of the way it explodes in the mine.'

'But,' said Willie, 'I liked that picture of the mine. We saw the shaft, and the



great cage hanging by its strong chains.

'The cage was coming down full of miners. At the bottom there was a truck loaded with coal ready to be sent up.'

'Yes,' said Fred, 'and we saw the wide road cut through the coal, and the wagons and horses going along.'

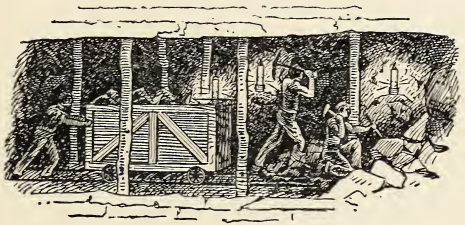
'Horses!' said Norah.

'Yes, little girl, horses,' said Fred.

'I thought I should like to be one of those boys to have a whip, and go for a ride along that funny road.'

'What, all in the dark?' said Norah.

'Well, it isn't very light of course. But it isn't so dark as you think, for each wagon has to carry a lamp. That shows a little light as they go along.'



'I shouldn't like it,' said Norah.

'Well,' added Fred, 'in another part of the picture we saw the men at work getting the coal. They were working hard, digging it out with pick-axe and shovel. Teacher says they are called hewers. They hew or dig out the coal.

'As they dig it out it is thrown into trucks, and the trucks are pushed along a little railway by boys. These boys are

called putters. They put or push the trucks along.'

'Teacher says it is very very hot down in the mine,' said Willie. 'All the workers are nearly naked.'

Lesson XXXVII

More about Leaves

'We have learned some new things about leaves to-day, Norah,' said Fred, 'and I want to try and tell you all about it. But before I begin you might think of some of the things we told you about leaves the other evening.'

'Well,' said Norah, 'I know that all leaves have veins running through them. In some leaves the veins run side by side, but in most of the leaves the veins spread about in a sort of network. The veins all come from the ribs, which stretch across the blade, and the ribs spring from the footstalk of the leaf.'

'That's very good,' said Fred. 'Now listen, while I tell you the most wonderful thing of all about the leaves.

'Teacher says that the surface of the leaf blade is crowded with tiny holes or pores.'

'I suppose,' said Norah, 'our eyes are not sharp enough to find them, for I cannot see them.'

'No,' said Fred, 'we children can't see them, but they are there, Norah. They are breathing pores. The leaves breathe in air through these pores.'

'You know what the root-hairs do?'

'Oh yes,' said Norah; 'they absorb liquid food from the soil.'

'Well then,' said Fred, 'this liquid food rises upward through the stem and branches, and along the footstalk till it reaches the leaves. Teacher says the earth-food, which the roots absorb, is no use to the plant till it has passed through the leaves. It flows through the footstalk, then through the ribs, and then the veins

carry it all through the leaf. While it flows through the leaf, it absorbs some of the air, which the breathing pores take in. It is this that makes the liquid into food fit for the plant.'

Lesson XXXVIII

More about the Mine

'Fred,' said Norah, 'I've been thinking about those dreadful mines. You say there is always some of that bad gas coming out of the coal.

'I should think that, after a time, the mine would get full of it. How do the men manage to breathe down there? I wonder it does not choke them.'

'Teacher has made that all clear to us now,' said Fred.

'Every mine has two shafts. They are a long way from each other. Only one of them is used to send the cages up and down. There is always a great fire burning at the bottom of this. The fire

makes the air all round very hot, and, as all hot air is light, it rises and rushes up the shaft. As this air goes up, some more air must come from somewhere to take its place. Where do you think this other air comes from, Norah?'

'Does it rush down the second shaft, and along the coaly roads and streets?' asked Norah.

'That's just it,' said Fred. 'What a thoughtful little girl you are!'

'There is always plenty of fresh air, you see, rushing through the mine. The bad gas is driven out, before it can do any harm.'

'Do let me tell Norah about that grand lamp, which they use in the mine,' said Willie.

'All right,' said Fred, 'go on.'

'The lamp is only a simple oil lamp,' said Will. 'But the clever part of it is that the flame is shut in all round with wire gauze. Every man lights his lamp and locks it up before he goes down. It

must not be opened. The flame burns inside, but it cannot get out to the bad gas in the mine. This makes it quite safe for the men. The lamp is called the Safety Lamp.'

'How clever the man must have been who thought of it!' said Norah.

'Yes, he was,' said Fred. 'His name was Davy, and the lamp is still called the Davy Lamp.'

Lesson XXXIX

Flowers

'Come out into the garden,' said Fred, 'and let us have a chat about the flowers. Can you tell me what is the use of the flowers, Norah?'

'They have to form seeds,' said Norah. 'We sow the seeds the next season, and they grow up into new plants.'

'Quite right,' said Fred. 'Look at all

these pretty flowers on the table. They seem to be made of leaves, but the leaves are not coarse and green, like the real leaves of the plant. They are soft and smooth and thin. If we take them in our hands, we are almost sure to bruise them. We may call them the flower-leaves. They are not all alike. See, there are red, white, pink, blue, yellow — all sorts of gay colors.'

'It is these flower-leaves that make our gardens look so pretty,' said Norah.

'Yes,' said Fred, 'but the flower-leaves, after a time, are of no further use. They fall off.

'Let us strip off the flower-leaves from some of our flowers. That will do. Now what have we got inside?

'These little slender stalks that stand

up in a circle are the stamens. Teacher showed them to us this morning.

'Look, Norah,' he went on, 'at the top of each of them there is a little yellow knob. Teacher says these knobs are little boxes filled with yellow dust. We call this dust pollen.

'If we touch one of them, we shall get some of the dust on our fingers.

'Now, watch while I strip off these stamens. What have we got left?'

'There is another stalk—a big one—in the middle of the stamens,' said Norah.

'Yes,' said Fred, 'this is all there is left. It is called the pistil. The seeds grow inside it; for it is not a stalk, but a box. When the stamens are no longer wanted they drop off. But the seed-box,

with its seeds, grows bigger and bigger, till it is quite ripe.'

Lesson XL

What we mean by Elastic

'Come and sit down, Norah,' said Willie. 'I've got something new to show you. This is a piece of india-rubber band. Look, if I pull it I can stretch it nearly twice as long.'

'Well, what of that?' said Norah. 'Anybody could do that.'

'Don't be in such a hurry,' said Will. He let go one end, and the india-rubber sprang back. 'This is what I wanted to show you,' said he. 'The india-rubber will stretch when we pull it, and it will spring back to its proper size and shape when we let go.

'Look,' he added. 'These pieces of cloth and flannel do the same. We say that india-rubber, cloth, and flannel are elastic. They stretch when we pull them, and spring back when we let go.'

'But teacher showed us,' said Fred, 'that there are other things, besides india-rubber, that spring back and are elastic. He showed us a cane, and a stick of whalebone, and bent them to make the two ends meet. They sprang back when he let go, because they are elastic.

'He squeezed a sponge up in his hand. It sprang back when he opened his hand, because it is elastic.

'He forced a cork into a bottle. The cork went in, because he made it smaller by squeezing it. When he pulled the cork out again, it sprang back to its right shape and size, because it is elastic.

'So you see, Norah, all these things, —the india-rubber, flannel, cloth, cane, whalebone, sponge, and cork,—are elastic; but they are not elastic in quite the same way. One shows that it is elastic when it is pulled, another when it is bent, and another when it is squeezed out of shape.'

SUMMARY OF LESSONS

Lesson I.—Water

We cannot pile up water in a heap; it always keeps a level surface. Water breaks up into little drops, and flows about. Water always flows down.

Lesson II.—Water—A Liquid

Water has no shape of its own. It always takes the shape of the vessel which holds it. Water, milk, oil, and vinegar are liquids.

Lesson III.—Solids

Solids do not flow about, and do not fall away in drops, as water does. They do not take the shape of the vessels which hold them, but have a shape of their own.

Lesson IV.—Liquids and Solids

Wax is a solid. We can change it into a liquid over the fire. The fire melts the wax. When it gets cold it becomes solid again. Ice is solid water.

Lesson V.—The Cat

The cat is made to kill and eat other animals. It has a wide mouth, with four great pointed teeth for seizing its prey. All the teeth have sharp, jagged points fit for cutting through flesh. None of them are made for chewing. The jaw moves only up

and down. The tongue is rough. The cat's eyes have a curtain in front. The curtain opens wide when it is getting dark, so that the cat can see well when other animals cannot see at all. In the daytime the curtain closes, and the pupil of the eye is only a narrow slit.

Lesson VI.—More about the Cat

The cat's whiskers help it to feel its way when it is too dark to see. The cat walks on its toes, and the toes are padded, so that they do not make any sound as they tread. There are five toes on the front paws and four on the hind ones. Each toe has a strong, sharp claw for seizing the prey. The cat keeps its claws drawn up in a sheath, except when it is angry.

Lesson VII.—Hard and Soft Bodies

Di-a-mond is the hardest of all bodies. It will cut glass. A steel knife will not even scratch glass. Steel is harder than iron; iron is harder than lead; wood is harder than cork. The hard body will scratch a soft one.

Lesson VIII.—Porous Bodies

Sponge is full of holes. These holes are called pores. Porous means full of holes. Sponge is a porous body. All things that are full of holes are porous. Bread, chalk, lump-sugar, and salt are porous bodies.

Lesson IX.—The Dog

The dog, like the cat, is fond of a piece of raw meat. He is a flesh-eater. His teeth are just like the cat's teeth. His jaw, too, has only one movement—up and down. He does not chew his food. His teeth are for cutting flesh, not for chewing. The dog's eyes have no curtain in front, and the pupil is never a long, narrow slit. He walks on his toes, and his toes are padded. He cannot draw his claws back. He makes a noise when he walks. His tongue is not rough, like the cat's tongue. The dog per-spires through his tongue.

Lesson X.—Dogs

The dog is man's best friend. He is a clever, loving, useful animal.

The hounds are swift runners. They are used for hunting. There are grey-hounds, stag-hounds, fox-hounds, blood-hounds, and deer-hounds.

The Saint Ber-nard dog is a strong, noble fellow. He finds people who have been lost and buried in the snow.

The New-found-land dog is also a grand fellow. He swims well, and saves people from drown-ing.

The bull-dog and the mastiff are watch-dogs. The sheep-dog takes care of his master's sheep.

Lesson XI.—A Piece of Clay

Clay is a mineral; it is dug out of the ground. Dry clay is porous; it absorbs water. Moist clay is not porous; it will not absorb water. Moist clay is plastic. We can mould it into any shape we please.

Lesson XII.—Clay—Its Uses

Cups and saucers, plates and dishes, basins and jugs are made of clay; and so are bricks, tiles, chimney-pots, and flower-pots. We call these things earth-en-ware. While the clay is moist and plastic, the men mould it into the proper shape for all these things, and then bake them in hot ovens till they are hard.

Lesson XIII.—Clay—Its Uses

Vessels made of baked clay are porous. Bricks and flower-pots are porous. Cups and saucers, plates and dishes, basins and jugs are glazed, to make them smooth and shiny like glass. After this they are not porous.

Lesson XIV.—The Cat's Big Cousins—The Lion

The lion is a great, fierce cat. His mouth, teeth, eyes, whiskers, and paws are just like those of the cat, but much

larger and stronger. He roars like distant thunder. He lives wild in the forests of some lands. He sleeps all day in his den, and comes out in the evening to catch his prey. Like the cat, he can see well when there is very little light. He kills and eats animals as big as the horse and the cow.

Lesson XV.—The Cat's Big Cousins—The Tiger

The tiger is another great, fierce cat. He has a fine, striped, glossy coat. He is even more cruel than the lion. He is a terror to all the animals of the forests in which he lives.

The leopard, the panther, and the puma are other great savage cats. The leopard has a handsome, spotted coat.

Lesson XVI.—Wolves and Foxes

The wolf is one of the dog's savage cousins. He is in every way like the dog, except that he is fierce and cruel. Wolves chase their prey in packs—a great many all together.

The fox is also a wild cousin of the dog. He lives in a hole in the ground. He catches and kills rabbits, fowls, ducks, and geese; and takes them home to his den to devour them.

Lesson XVII.—A Piece of Putty

Putty is a plastic substance. It is not porous. It is water-proof. New putty is soft, sticky, and plastic. When it dries it becomes almost as hard as stone. It holds the pane of glass firmly in the window. The rain cannot come in, because putty is water-proof.

Lesson XVIII.—Putty—What it is

Putty is made of whiting and linseed-oil. Whiting is made from chalk, and chalk is dug out of the ground; it is a mineral. Linseed-oil is made from lin-seed, the seed of the flax plant. Linseed-oil makes the putty sticky, plastic, and water-proof.

Lesson XIX.—Gutta-Percha

Gutta-percha is a plastic substance. It becomes soft and plastic with heat. When it gets cold it becomes hard again. It makes good soles for our boots, because it is water-proof.

Lesson XX.—A Piece of Salt

When we put salt into water it breaks up into such little pieces that we cannot see them. We dis-solve the salt in the water. It does not melt. We can also dis-solve sugar, soda, alum, and lime in water. But we can't dis-solve stones, chalk, iron, or wood.

Lesson XXI.—The Sheep

The sheep chews the cud. It has no teeth in the front of its top jaw; it has only a pad there. It has great teeth for chewing or grinding; and the jaw moves from side to side, as well as up and down. The sheep tears off and swallows each mouthful of grass without chewing it, then brings it all back into its mouth to be chewed, and at last swallows it again. The sheep has a cloven hoof. Its foot has four toes; but it walks only on the two front ones. It has a thick coat of wool.

Lesson XXII.—Salt

Brine is salt water. The salt is in the water, but we cannot see it. If we boil the brine, the water will fly away in steam, and we can get the salt back.

Lesson XXIII.—The Pig

The pig likes to grub in the ground for acorns, beech-nuts, and roots. His hard, strong snout is made for grubbing—a cat could not do it. The pig has some teeth for tearing flesh, and some for chewing or grinding. His jaw moves from side to side as well as up and down. He will eat almost anything. He has a cloven hoof. But he does not chew the cud, like the sheep.

Lesson XXIV.—Rock-Salt—Table Salt

Rock-salt is dug out of the earth. It looks like a piece of smooth, shiny stone. Water is always soaking through the earth. Some of this water, as it soaks through, dis-solves the rock-salt, and makes brine; and then we get a brine-spring. Men pump up this brine and boil it. The water boils away, and leaves the salt behind. This is the white salt we see on the dinner-table.

Lesson XXV.—A Plant

Plants live and grow in the ground. Minerals are dug out of the ground, but they do not grow there, and they are not living things. The plant has a root, stem, buds, and leaves; when it is big enough the flowers and seeds come.

Lesson XXVI.—Sugar

Sugar comes from the sweet juice of the sugar-cane, a great plant which grows in hot lands far away. When the canes are ripe, they are cut down, and the sweet juice is squeezed out of them. Men boil the juice in great pans, and as the water of the juice boils away, the sugar is left behind. The thick, brown part of the juice is molasses.

Lesson XXVII.—The Root of a Plant

The root holds the plant in the ground, and feeds it. All roots are not alike. Some plants bear flowers and seeds the same year that they are sown. They live only that one year. These have stringy or fibrous roots. Some plants do not bloom at all the first year. Their flowers and seeds come in the second season. They have thick, fleshy roots, like the roots of the radish, carrot, turnip, and parsnip.

Lesson XXVIII.—Loaf Sugar

The hard, white, loaf sugar, which we use for our tea, is made from coarse, brown, moist sugar. This coarse sugar is

first mixed with lime, and then put into water to dis-solve. It forms a syrup, which is made to trickle through porous bags, and then through charcoal. This takes away its brown color and leaves it clear ; after which it is boiled. As the water boils away, the syrup thickens, and it is put into moulds to cool. Some of it will not become solid ; it drains away and forms golden syrup.

Lesson XXIX.—The Root and its Work

The root feeds the plant with food from the soil. The root-hairs are the real feeders. They are made up of a great many very small cells, with soft, thin walls. These cells take in food, which the rain dis-solves out of the soil, and pass it upward to feed the plant.

Lesson XXX.—About Burning

We get hay, straw, paper, muslin, cal-i-co, and wood from plants. These, and all other things which come from plants, blaze up quickly in the fire. Silk, cloth, wool, feathers, leather, and whale-bone come from animals. They all burn slowly, but do not burn well.

Lesson XXXI.—The Stems of Plants

The stem of the plant makes its way up towards the light and air. Stems are not all alike. Trees and shrubs have hard, woody stems ; herbs have soft green stems. Some stems are very slender and weak. There are twining stems, climbing stems, creeping stems, and underground stems.

Lesson XXXII.—Coal

Coal is dug out of the ground, like stone, clay, chalk, and rock-salt. We call it a mineral ; the great deep hole in the earth, where the men dig it up, is a mine ; the men who dig it are miners. We use coal for fuel, because it burns well, and gives out great heat.

Lesson XXXIII.—Coal

Coal was not always in the ground, as it is now. It has been formed from the remains of great forests, which once grew on the earth. The trees, long, long ago, sank down and got buried and changed into coal.

Coal gives us gas to light our streets, and shops, and houses; and coke to burn in our fires.

Lesson XXXIV.—Leaves

A leaf consists of a blade and a footstalk. In most leaves ribs stretch across the blade, and veins spread over it in every direction. We call these net-veined leaves. In some leaves the veins run side by side. These are called par-all-el veined leaves.

Lesson XXXV.—Coal—The Mine

Coal is found in beds or layers hundreds of feet deep in the earth. The shaft of the mine is the great pit, which stretches down to the coal-bed. The miners go up and down the shaft in great cages. At the bottom of the shaft they dig out wide roads and streets in the solid coal.

Lesson XXXVI.—The Mine and the Miners

Men, boys, and horses, all have to work very hard in that dark underground town. The men hew or dig out the coal; the boys push it along on little trucks; the horses draw the loaded wagons to the bottom of the shaft.

Lesson XXXVII.—More about Leaves

The surface of the leaf-blade is crowded with breathing-pores. The leaves breathe in some of the air through these pores. This makes the sap into food fit for feeding the plant.

Lesson XXXVIII.—More about the Mine

The great mass of coal down in the mine is always giving out gas. This gas will explode if a flame comes near it. The men use the Davy lamp, and they are quite safe, for the flame is shut in all round with wire gauze.

Lesson XXXIX.—Flowers

The flowers have to form the seeds from which new plants will grow. They consist of the pretty flower-leaves outside, and the stamens and pistil inside. In the very middle of all the parts is the seed-box.

Lesson XL.—What we mean by Elastic

India-rubber stretches when we pull it, and springs back when we let go. It is elastic, and so are cloth and flannel. Whale-bone and cane bend easily, but spring back when we let go. They are elastic.

Sponge and cork can be squeezed, and made smaller, but they spring back when we let go. Sponge and cork are elastic.

THE END

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